Vegetable Transplant Stress Conditioning

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INTRODUCTION

Using transplants in the desert Southwest is increasing; for that reason, we are continuing our work on transplant stress conditioning. Our previous work concentrated on transplant nutrient conditioning as a means of overcoming transplant shock. Partial defoliation and traditional hardening methods may also be effective. Leaf pruning decreases transpirational water loss until adequate root replacement can support a larger leaf area. Traditional reduction in water and/or fertilizer applications prior to transplanting are methods still employed by many nurseries shipping transplants into Arizona. Our objectives were to evaluate clipping and hardening as methods for stress-conditioning transplants for desert vegetable production.

MATERIALS AND METHODS

'Snowcrown' cauliflower (Brassica oleracea var botrytis) was seeded in peat:vermiculite mix (1:1, v:v) in model 100A Todd planter flats. In Experiment 1, seedlings were fertilized with six applications of N at 50, 150 or 450 mg N l^{-1} beginning two weeks after seeding. The day before transplanting, 0, 25, 50 or 100% of the leaf area of the plants in each fertilizer regime was removed by clipping with scissors. Four replications of each treatment were transplanted into a randomized complete block design using a Mechanical Transplanter.

In Experiment 2, seedlings were fertilized with six applications of 100, 200 or 400 mg N l^{-1} beginning 4 days after emergence. One week before transplanting, the following 'hardening' treatments were applied within each N regime:

1. Water 1x/day, no fertilizer
2. Water 1x/day, fertilizer on day 3 of 'hardening'
3. Water 2x/day, fertilizer on day 3 of 'hardening'
4. Water 2x/day, fertilizer on days 2, 4 and 6

Li-Cor steady-state porometer readings were taken before and after transplanting.

RESULTS

Experiment 1 -- As before, the high-N transplant production regimes resulted in larger, more succulent plants (Table 1). Air-leaf temperature differences reflect the cooling effect of transpiration. Temperature differences and transpiration declined linearly as pre-transplant N levels increased in response to increased succulence, lower root-shoot ratios (not shown) and partial stomatal closure.

Although transpiration is favored by large root-shoot ratios, the slight increase resulting from the 50% defoliation treatment was offset by reduced leaf area (Table 2). The very high root-shoot ratios of the 100% defoliation may have enhanced elevated transpiration in newly formed leaves one week after transplanting, even above the rate of non-defoliated control plants. Even so, the lack of sufficient leaf area for transpirational water flow severely restricted the transplants' adaptation to stress, even of those plants with high carbohydrate reserves (data not shown) produced with high N. Consequently, poor stands were achieved, growth of the remaining plants was retarded and DAT to maturity increased. Clipping did not enhance yield.

Experiment 2 -- Increases in pre-hardening N levels resulted in linear increases in transplant leaf area and linear decreases in root-shoot ratios; these responses persisted (though modified) after hardening (Table 3). Equal water and fertilizer treatments (Lo/Lo or Hi/Hi) during the hardening period resulted in larger transplants (within each pre-hardening N level) than when watering frequency exceeded fertilizer frequency; this was most likely due to leaching. With the exception of the Lo/Lo 200 mg N l^{-1} treatment, these larger transplants resulted in heavier heads at harvest. The Hi/Lo hardening treatments consistently resulted in greater transpiration, but they did not induce more rapid recovery from transplant shock. Those transplants in each pre-hardening N level which continued to receive luxurious amounts of water and fertilizer (in essence, no hardening) out-yielded the others. Therefore, the 'hardening' treatments imposed here were not beneficial.

Table 1. Pretransplant effects of N on cauliflower (Brassica oleracea var. botrytis cv Snowcrown) seedling height, stem diameter, leaf/air temperature difference, diffusive resistance and transpiration (seeded 8/8/88, transplanted 9/7/88).

N (mg/l.)	Plant ht. (cm)	Stem diam. (mm)	Temp. diff. (°C)	Diff. res. (s cm^{-1})	Transp. (g cm^{-2} s^{-1})
50	4.8	1.9	3.7	2.98	9.50
150	6.1	2.1	1.6	4.41	8.17
450	8.1	2.7	0.9	5.19	7.58

Table 2. Main effects of clipping on 'Snowcrown' cauliflower leaf area, root/shoot (dwt.), leaf-air temperature difference, diffusive resistance and days after transplanting (DAT) to harvest (transplanted 9/7/88, harvested 11/28-12/19/88).

Leaf area removed %	Leaf area (Cm^2)	Root/ shoot	Temp. diff. (°C)	Diff. res. (S cm^{-1})	DAT
0	31.0	0.21	2.5	1.77	89
25	16.9	0.20	2.5	2.25	90
50	12.5	0.26	2.0	2.06	90
100	0.8	0.68	2.8	1.61	95

Table 3. Nitrogen and 'hardening' treatment effects on 'Snowcrown' cauliflower seedling leaf area, root-shoot ratio, diffusive resistance, transpiration and yield (transplanted 9/26, harvested 12/19/88).

N (mg/l)	Hardening (H_2O)	(Fert.)	Leaf area (Cm2)	Root/ shoot (dwt)	Diff. Res. (S Cm^{-1})	Transp. (g Cm^{-2} S^{-1})	Head wt. (g)
100	Lo	No	19.2	.156	2.0	10.4	618
	Lo	Lo	23.4	.147	2.1	9.3	695
	Hi	Lo	21.1	.150	1.0	15.8	665
	Hi	Hi	25.1	.147	2.7	10.8	751
200	Lo	No	34.1	.115	2.6	12.8	689
	Lo	Lo	36.8	.107	1.3	14.9	641
	Hi	Lo	35.5	.118	1.2	16.4	682
	Hi	Hi	43.3	.106	1.8	13.0	723
400	Lo	No	36.6	.106	3.7	10.4	624
	Lo	Lo	44.0	.104	2.1	10.3	734
	Hi	Lo	40.7	.107	2.3	11.6	651
	Hi	Hi	48.8	.101	6.2	6.0	813